PATENT

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

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| Applicant: | Mary E. Pierce | |
| Application No: | 09/737,109 | Group Art Unit: 1771 |
| Filing Date: | December 14, 2000 | Examiner: A. Wachtel |
| Entitled: | **LOW BORON CONTAINING MICROFIBER GLASS FILTRATION MEDIA** | |
| Atty. Docket No: | 72545-37 | |

Certificate of Mailing (37 C.F.R. 1.8(a))

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## 1.132 Declaration of Mary E. Pierce

I, Mary E. Pierce, residing at 206 Old Turnpike Road, Mason, NH 03048, hereby declare as follows:

1. I am an Administrative Manager in the Research and Development laboratory at Hollingsworth & Vose Company, and my responsibilities include high efficiency glass fiber media development. I have been working at Hollingsworth & Vose Company for twenty-four years and I have been developing glass filter media grades for nineteen years.

2. I obtained a Bachelor of Science degree in Applied Chemistry.

3. I have read the above-referenced application, and I fully understand the materials disclosed and claimed therein.

4. The above-referenced patent application is directed to a nonwoven filter media formed from glass wool fibers essentially free of boron and chopped glass fibers essentially free of boron.

5. In the course of the research that resulted in the invention described and claimed in the above-referenced patent application, I set out to develop a boron-free replacement for traditional HEPA and ULPA filters. It is known that boron-containing filters generate boron contaminants when subject to humid conditions. Thus, my goal was to provide an essentially boron-free replacement for use in clean room environments. I prepared filter media using glass wool fibers essentially free of boron and chopped glass fibers essentially free of boron (the chopped glass fibers contained less than the claimed ranges of aluminum oxide and calcium oxide). When tested, however, these filter media had crease tensile strengths after humid aging that were not suitable for use in air filters. I unexpectedly discovered that the use of a chopped glass fiber having more than about 10% by weight of aluminum oxide and more than about 20% by weight of calcium oxide produced an essentially boron-free filter media that was very resistant to degradation of crease tensile strength in humid environments. Originally, I did not expect the high aluminum oxide and calcium oxide contents in the chopped glass fibers to improve the crease tensile strength after humid aging of the filter media because these components represented only a fraction of the total weight of the filter media.

6. The significant increase in the humid aging properties of the filter media of the present invention over prior art filter media is demonstrated in the attached Tables 1-3, and in the attached Chart. Table 1 contains crease tensile strength testing results for a series of filter media formed from Boron Free Glass as the microfiberglass wool component and Chem Glass as the Chopped Glass component. The composition of each of these glasses is set forth in the table at page 12 of the application. It is important to note that the chopped glass component contains 5-9% aluminum oxide and less than 10% of calcium oxide. This data is illustrated in blue on the

chart attached hereto and entitled "Crease Tensile Strength Comparison." As shown, boron-free filter media having ***low*** amounts of calcium and aluminum oxide, outside and below the claimed range, have a low crease tensile strength that significantly decreases over time.

7. Table 2 contains crease tensile strength testing results for a series of filter media formed from Boron Free Glass as the microfiberglass wool component and Boron Free Glass as the Chopped Glass component. Again, the composition of each of these glasses is set forth in the table at page 12 of the application. It is important to note that the chopped glass component contains 10-15% aluminum oxide and 20-25% calcium oxide. This data is illustrated in red on the chart attached hereto and entitled "Crease Tensile Strength Comparison." As shown, boron-free filter media having ***high*** amounts of calcium and aluminum oxide concentrations (in the claimed range) result in a high crease tensile strength that does not show a significant decrease over time. This was unexpected.

8. Table 3 attached hereto contains crease tensile strength testing results for a typical boron-containing filter media formed from Borosilicate Glass as the microfiberglass wool component and E Glass as the Chopped Glass component. Again, the composition of each of these glasses is set forth in the table at page 12 of the application. This data is illustrated in yellow on the chart attached hereto and entitled "Crease Tensile Strength Comparison." As shown, the filter media of the present invention (shown in red) have crease tensile strengths equal to or even greater than the crease tensile strength of the control, thus providing a boron free replacement for traditional boron-containing HEPA and ULPA filters.

9. The comparative data is best illustrated in the chart in which the crease tensile strength properties of filter media prepared according to the claimed invention are shown in red (Trials A-K) and the same properties of the same filter media, with lesser amounts of calcium oxide and aluminum oxide than is claimed, are shown in blue (Trials 1-6). As clearly illustrated, the claimed invention provides filter media having an initial crease tensile strength that ranges from about 2.6 lb/inch to 5.45 lb/inch, and the crease tensile strength is significantly retained after humid aging for up to 96 hours. This is significant in industrial applications because the

claimed filter media meets and sometimes exceeds industry accepted standards allowing for their use in humid environments, such as clean rooms, which have a relative humidity of greater than 45%. It is also significant that the properties of the claimed invention compare favorably to (and in many cases exceed) the properties of a control, shown in yellow on the chart, that contains boron. Boron-containing filter media are known to generate boron contaminants when subjected to humid conditions, thus the present invention advantageously provides a suitable boron-free replacement for boron-containing filter media.

10. I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Date: September 30, 2003

Mary E. Pierce

**Table 1: Filter Media Containing High Amounts of $Al_2O_3$ and CaO**

The filter media in Trials A-K each contain a boron-free microfiberglass wool component, and a boron-free chopped filament glass component.

| Time | Trial A | Trial B | Trial C | Trial D | Trial E | Trial F | Trial G | Trial H | Trial I | Trial J | Trial K |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 5.45 | 4.8 | 3.4 | 4.8 | 4.5 | 4.8 | 3.5 | 4.3 | 2.6 | 3.3 | 3.2 |
| 24 | 2.95 | 3.4 | 2.8 | 4.6 | 3.6 | 3.8 | 2.7 | 2.6 | 2.4 | 2.4 | 2.7 |
| 48 | 1.48 | 3.2 | 2.7 | 3.1 | 3.8 | 3.7 | 2.2 | 2 | 1.5 | 2.2 | 2.6 |
| 72 | 0.87 | 3.3 | 1.9 | 3.2 | 3.2 | 3.8 | 2 | 1.7 | 1.2 | 1.4 | 1.5 |

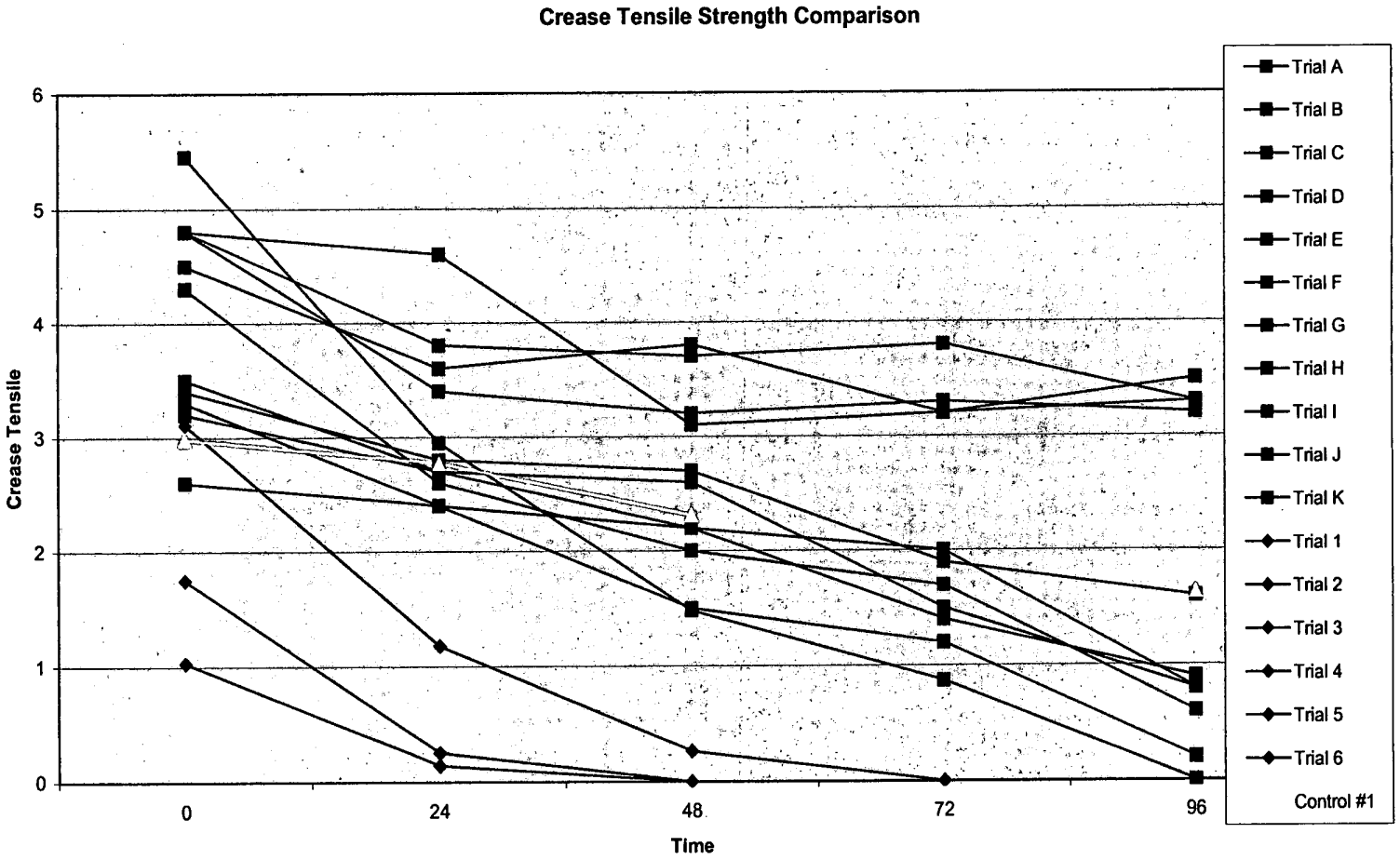
**Table 2: Filter Media Containing Low Amounts of $Al_2O_3$ and CaO**

The filter media in Trials 1-6 each contain a boron-free microfiberglass wool component, and a boron-free chopped filament glass component.

| Time | Trial 1 | Trial 2 | Trial 3 | Trial 4 | Trial 5 | Trial 6 |
|---|---|---|---|---|---|---|
| 0 | 1.03 | 1.75 | 3.11 | 3.11 | 1.03 | 1.75 |
| 24 | 0.14 | 0.25 | 1.18 | 1.18 | 0.14 | 0.25 |
| 48 | 0 | 0 | 0.26 | 0.26 | 0 | 0 |
| 72 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 3: Control - Boron Containing Filter Media**

| Time | Control |
|---|---|
| 0 | 2.98 |
| 24 | 2.77 |
| 48 | 2.31 |
| 72 | |
| 96 | 1.63 |


Crease Tensile Strength Comparison
Crease Tensile
Time
0
24
48
72
96
0
1
2
3
4
5
6
Trial A
Trial B
Trial C
Trial D
Trial E
Trial F
Trial G
Trial H
Trial I
Trial J
Trial K
Trial 1
Trial 2
Trial 3
Trial 4
Trial 5
Trial 6
Control #1